TIMKEN
Where You Turn

Bearing Tester
User Guide

Contents

Document Outline

This User Guide contains useful information about the bearing tester, beginning with general information about instrument parts, user interface, batteries and settings.

A chapter explaining the theories of shock pulse measurement follows. It is advisable that you read this as it is valuable in order to understand measurement results and to evaluate them correctly.

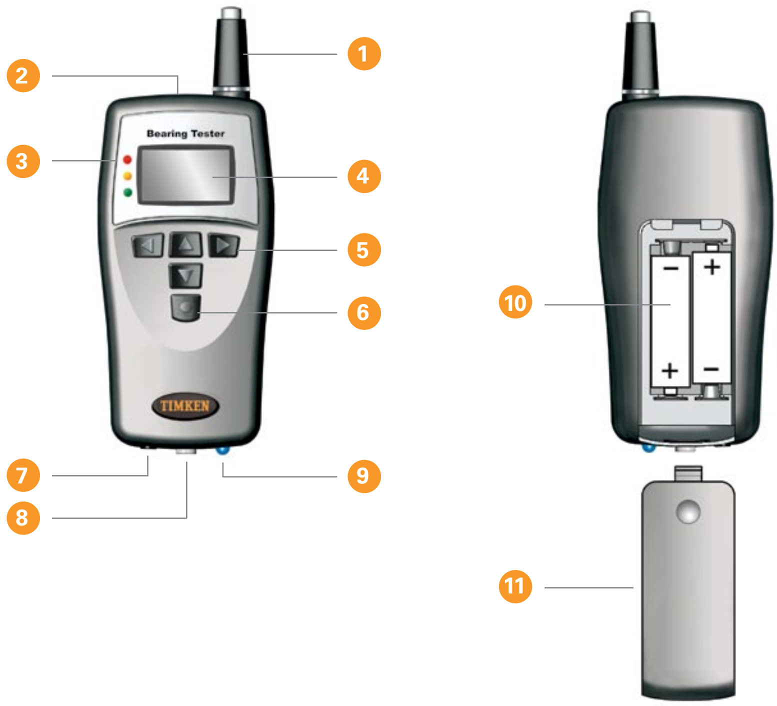
The shock pulse theories chapter is followed by chapters describing the hands-on use of the instrument and how to confirm and evaluate measurement results.

References to icons, displays and modes in the instrument are in bold text. References to instrument keys are in capital letters.

Instrument Overview

Instrument parts

1 Measuring probe
2 Temperature IR sensor
3 Condition indicators
4 Graphical display
5 Navigation keys
6 Measuring key and power on
7 Output for headphones
8 Transducer input
9 Measuring LED
10 Battery compartment
11 Serial number label



General description

The bearing tester is a shock pulse meter based on the well proven shock pulse method for quick and easy identification of bearing faults. The instrument has a built-in microprocessor programmed to analyze shock pulse patterns from all types of ball and roller bearings and display evaluated information on the operating condition of the bearing.

Bearing tester is battery powered and designed for use in harsh industrial environments. The graphic display (4) gives the condition readings and the LED indicators (3) give an immediate evaluated bearing condition in green-yellow-red.

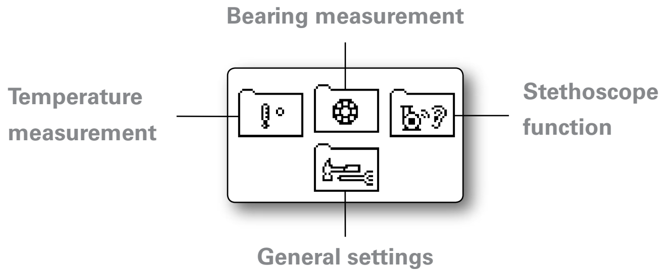
The shock pulse transducer (1) of probe type is built-in. All types of SPM shock pulse transducers for adapters and permanent installation can also be used, connected to the transducer input (8). The dBi value is programmed into the instrument and the measurement is started with key (6). The actual condition reading is displayed on the graphical display (4) as a carpet value "dBc" and a maximum value "dBm". The condition indicators (3) indicate the evaluated bearing condition in green-yellow-red. Headphones for listening to the shock pulse pattern can be connected to the output (7).

The Bearing tester can also be used for measuring surface temperature via the IR sensor (2), and for detecting machine sound irregularities via headphones using the stethoscope function.

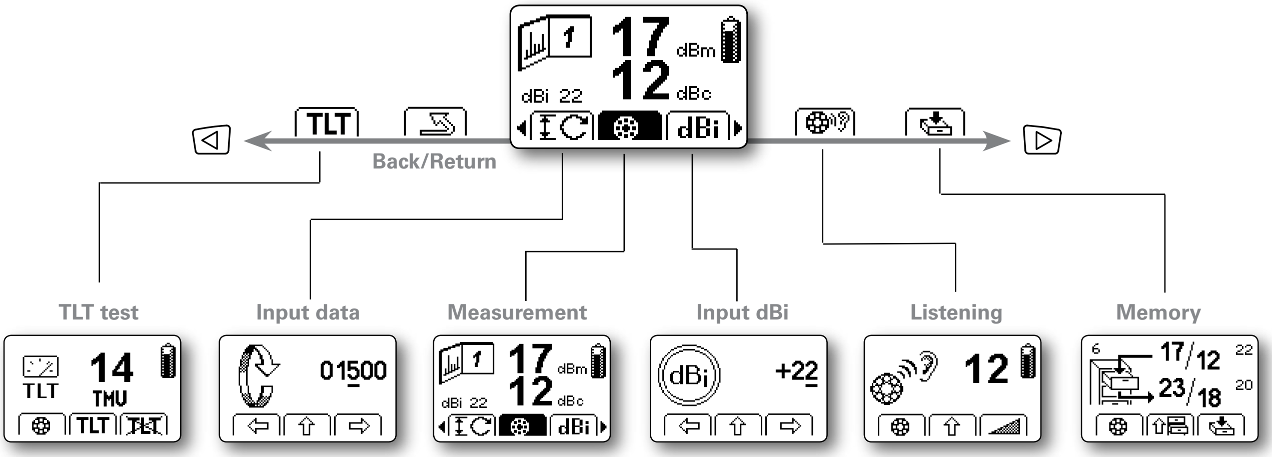
Internal or external probes can be used for listening.

Displays and icons

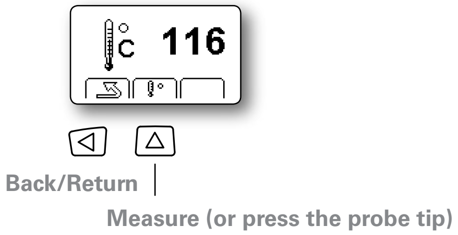
Main display



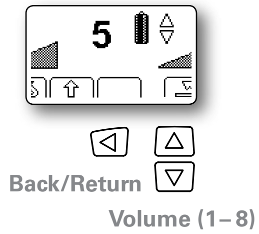
Bearing measurement



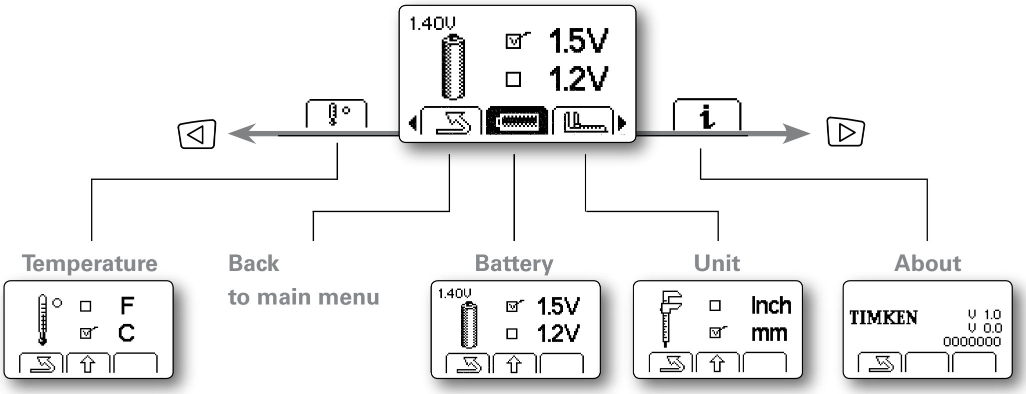
Temperature measurement



Stethoscope function



General settings



Start up

Pressing the measuring key (6) switches on the instrument.

Set up and measuring modes are selected with the arrow keys (5).

Measuring is started automatically whenever the internal probe is pressed in. When using external probes, measuring is started manually by pressing the measuring key (6) while in the Bearing mode.

The blue measuring LED (9) stops blinking when a measuring cycle is completed.

The green, yellow and red LEDs (4) beside the display indicate the bearing condition after an shock pulse measurement.

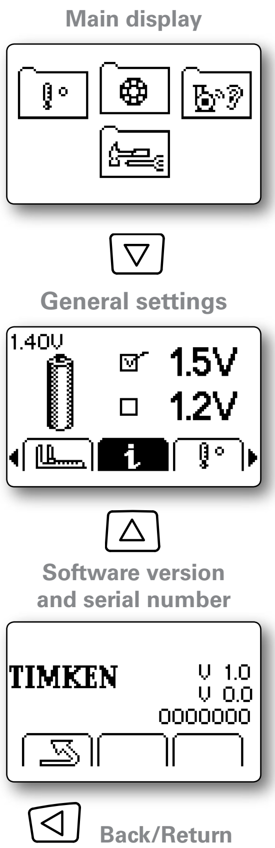
If not used, the instrument will automatically shut off after 2 minutes. It can also be shut off by simultaneously pressing the LEFT and RIGHT arrow keys.

When switched back on, the instrument will resume its last mode.

Serial number and software version

To check which software version is in your instrument and find out the instrument serial number, go to the Main display. Press the DOWN arrow key to enter the General Settings mode. Use LEFT/RIGHT arrow keys to highlight the Information icon (i), then press the UP arrow key to see the software version and serial number. To return to the General Settings mode, press the LEFT arrow key.

To return to the Main display, use LEFT/RIGHT arrow keys to highlight the Return icon, then press the UP arrow key.



Batteries

The instrument is powered by two batteries type MN 1500 LR6. Alkaline (AA) or rechargeable batteries can be used. Please note that rechargeable batteries must be removed from the instrument before recharging. The battery compartment is located at the back. Press and push the lid to open the compartment.

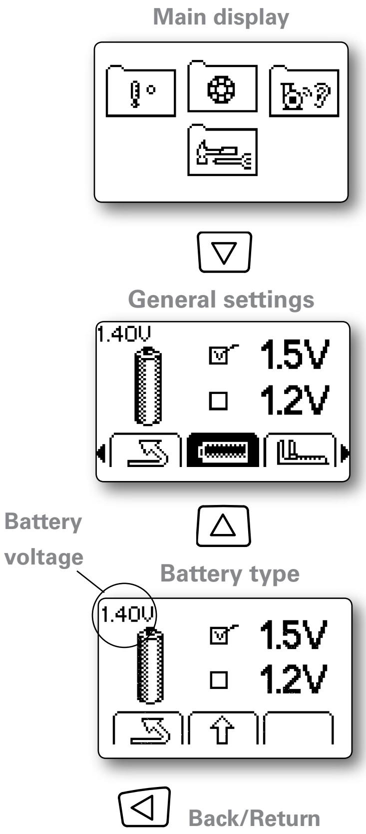
The battery test on the setup menu shows the present battery voltage. The battery status icon will show when the batteries are low and have to be replaced or recharged.

The battery life depends on how the instrument is used. Full power is only consumed while a reading is in progress: from pressing the measuring key until a measured value is displayed.

Before long-time storage of the instrument, keep in mind to remove the batteries.

Battery check

For exact battery voltage, go to the battery setup menu:



From the Main display, press the DOWN arrow key to enter the General Settings folder. Use LEFT/RIGHT arrow keys to highlight the battery icon, then press the UP arrow key to enter battery type setup. The present battery voltage is shown in the upper left corner.

To return to the General Settings menu press the LEFT arrow key.

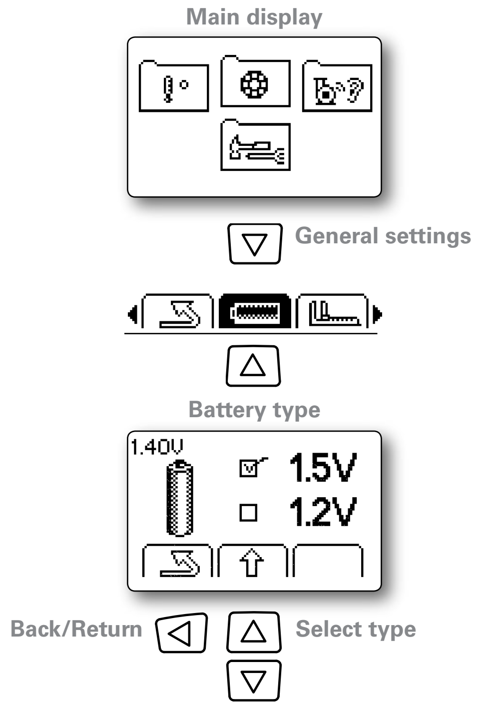
Settings

Battery type

Alkaline or rechargeable batteries can be used in bearing tester. The battery type has no influence on instrument functionality or operation, but should be set for the battery status icon to correctly show battery level.

From the **Main** display, press DOWN arrow key to enter the **General Settings** folder. Use LEFT/RIGHT arrow keys to highlight the **Battery** icon, then press the UP arrow key to enter battery type setup. Use UP/DOWN arrow keys to set the battery type of your choice (1.2 V for rechargeable, 1.5 V for alkaline batteries). To save and return to the **General Settings** menu press the LEFT arrow key.

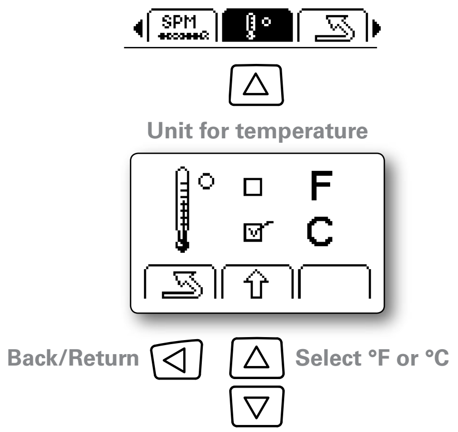
To return to the **Main** display, use LEFT/RIGHT arrow keys to highlight the **Return** icon, then press the UP arrow key.



Unit for temperature measurement

Temperature can be displayed in either **Celsius** or **Fahrenheit**. To choose your unit of measurement, use the DOWN arrow key in the **Main** display to enter the **General Settings** mode. Use the LEFT/RIGHT arrow keys to highlight the **Temperature** icon, then press the UP arrow key. Use the UP/DOWN arrow keys to set the measurement unit of your choice. To save and return to the **General Settings** menu press the LEFT arrow key.

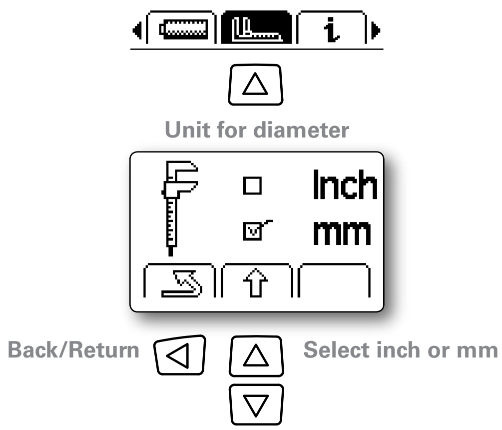
To return to the **Main** display, use the LEFT arrow key to highlight the **Return** icon, then press the UP arrow key.



Unit for bearing diameter setting

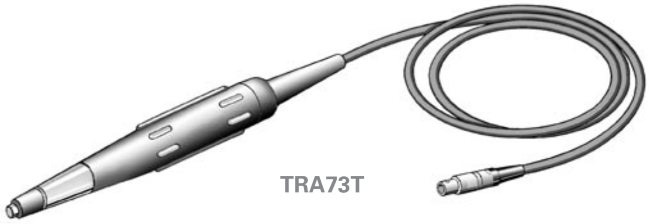
Bearing diameter can be displayed in either **mm** or **inch.** To choose your unit of measurement, use the DOWN arrow key in the **Main** display to enter the **General Settings** mode. Use the LEFT/RIGHT arrow keys to highlight the **Measurement** icon, then press the UP arrow key. Use the UP/DOWN arrow keys to set the measurement unit of your choice. To save and return to the **General Settings** menu press the LEFT arrow key.

To return to the **Main** display, use the LEFT arrow key to highlight the **Return** icon, then press the UP arrow key.

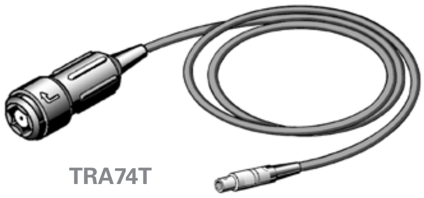


Accessories

15288T 15287T 15286T



TRA73T

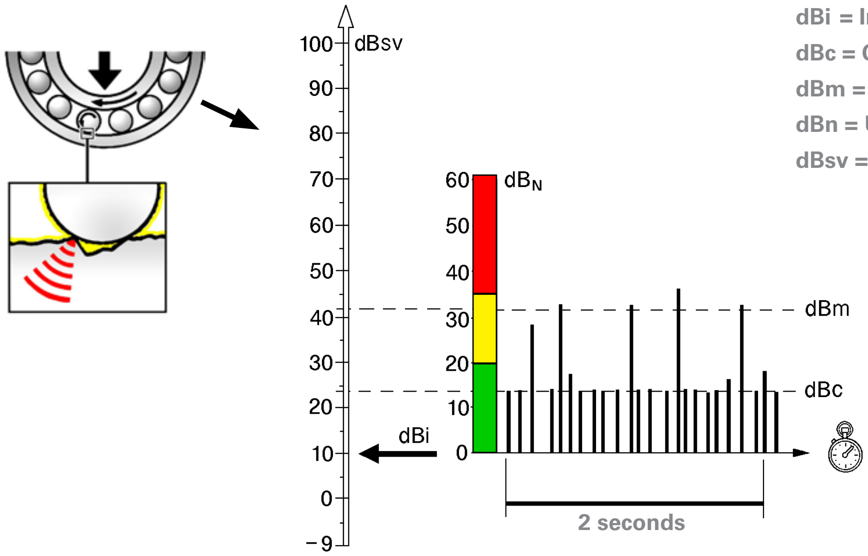


TRA74T

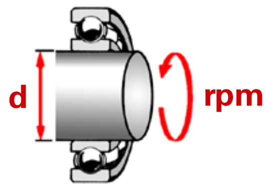
Accessories

TRA73T	External transducer with probe
TRA74T	Transducer with quick connector for adapters
15286T	Belt holder for external probe transducer
15287T	Belt case for accessories
15288T	Protective cover with wrist strap
EAR12	Headphones with ear defenders

Shock Pulse Measurement



dBi = Initial value of a bearing
dBc = Carpet value (weak pulses)
dBm = Maximum value (strong pulses)
dBn = Unit for normalized shock level
dBsv = Unit for absolute shock level



The initial value dBi depends on rpm and shaft diameter d.

The Shock Pulse Method

The bearing tester is based on the Shock Pulse Method. Measurements with the shock pulse method give an indirect measure of impact velocity, i.e. the difference in velocity between two bodies at the moment of impact. At the point of impact, a mechanical compression wave (a shock pulse) arises instantly in each body. The peak value of the shock pulse is determined by the impact velocity and is not influenced by the mass or the shape of the colliding bodies. Shock pulses in rotating ball and roller bearings are caused by impacts between raceways and rolling elements. From the points of impact the shock pulses travel through the bearing and the bearing housing. Extensive experience proves that there is a simple relationship between the bearing's operating condition and the value of the shock pulses.

A transducer detects the shock pulses in the bearing. The transducer signals are processed in the bearing detector's microprocessor and the measured shock pulse values are shown on the display. An headphone can be connected to the instrument for listening to the shock pulse pattern. Please note that this instrument cannot be used for plain bearings.

Shock pulses are short duration pressure pulses which are generated by mechanical impacts. Mechanical impacts occur in all rotating rolling bearings because of irregularities in the surfaces of the raceways and the rolling elements. The magnitude of the shock pulses depends on the impact velocity.

Carpet value dBc

Surface roughness (small irregularities) will cause a rapid sequence of minor shock pulses which together constitute the shock carpet of the bearing. The magnitude of the shock carpet is expressed by the carpet value dBc (decibel carpet value). The carpet value is affected by the oil film between rolling elements and raceways. When the film thickness is normal, the bearing's carpet value is low. Poor alignment and installation as well as insufficient lubrication will reduce the thickness of the oil film in the whole or parts of the bearing. This causes the carpet value dBc to rise above normal.

Maximum value dBm

Bearing damage, i.e. relatively large irregularities in the surfaces, will cause single shock pulses with higher magnitudes at random intervals. The highest shock pulse value measured on a bearing is called its maximum value dBm (decibel maximum value). The maximum value dBm is used to determine the operating condition of the bearing. The carpet value dBc helps to analyze the cause of reduced or bad operating condition.

Normalized and unnormalized readings

The bearing tester measures impact velocity over a large dynamic range. In order to simplify readout and evaluation, a logarithmic measuring unit is used: decibel shock value (dBsv).

dBsv is the general measuring unit for shock pulses. By measuring the shock pulses from a bearing in dBsv a value for their magnitude is obtained, for instance 42 dBsv. However, this value is only part of the information needed to judge the operating condition of the bearing. We also need a standard of comparison, i.e. a norm value for identical or similar bearings.

Such norm values have been obtained empirically, by measuring the shock pulses from a large number of new, perfect ball and roller bearings. They are called "initial values" **dBi** (decibel initial). The dBi value can be set manually or calculated by the instrument after input of rpm and shaft diameter (see chapter "Input data"). The highest dBi value that can be entered is +60, the lowest -9. Any attempt to enter values below this will result in dBi "- -" and an unnormalized shock pulse reading (see below).

By subtracting the dBi from the dBsv value we obtain the "normalized" shock pulse value or dBn (decibel normalized) of the bearing, for example: 42 dBsv–10 dBi = 32 dBn". The normalized shock pulse value dBn is the measuring unit for the operating condition of bearings. A maximum value of 32 dBn means "32 dB above normal", which implies "reduced operating condition" for the measured bearing. By programming the bearing tester with the dBi before taking a reading, the bearing condition will be indicated directly on the condition display in green-yellow-red for "good", " reduced" or "bad" operating condition for the measured bearing. "Bad operating condition" can be synonymous with "bearing damage", but the term also includes a number of other "bearing faults" which can be detected by shock pulse measurement. The initial value dBi of a bearing is directly related to its rotational speed and shaft diameter.

The absolute shock pulse level of a bearing, measured in dBsv (decibel shock value), is both a function of rolling velocity and of bearing condition. The dBi value of the bearing must be entered in order to neutralize the effect of rolling velocity on the measured value.

The bearing tester takes a sample count of the shock pulses occurring over a period of time and displays:

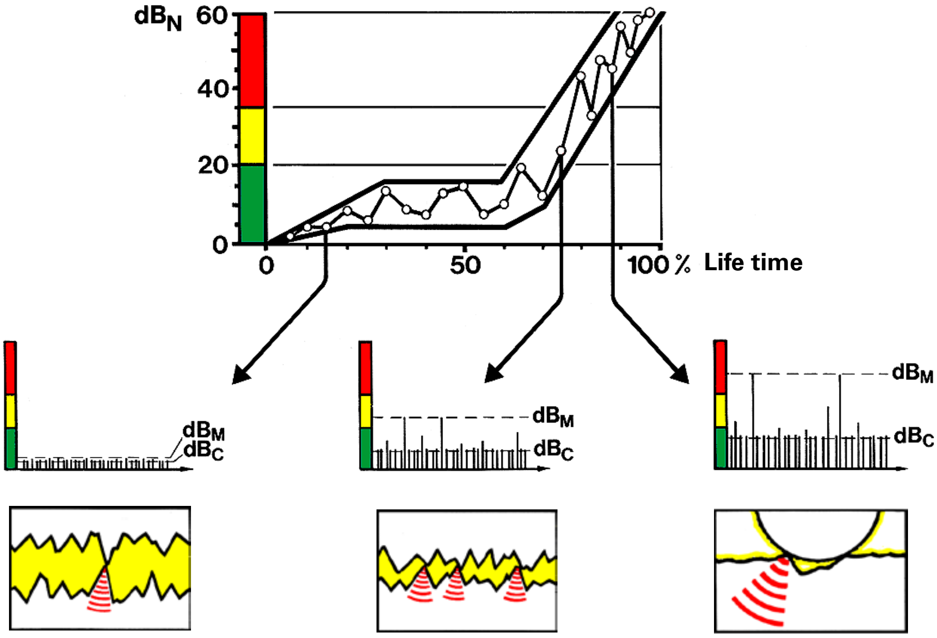
- *the **maximum value dBm** for the small number of strong shock pulses.*
- *the **carpet value dBc** for the large number of weaker shock pulses.*
- *a lit-up LED on the condition scale (for normalized readings only): green for dBn up to 20 dBn = good condition, yellow for 21-34 dBn = caution, red for 35 dBn and more = bad condition.*

The maximum value dBm defines the bearing's position on the condition scale. The difference between dBm and dBc is used for a finer analysis of the causes for reduced or bad condition.

Unnormalized readings

For unnormalized readings, set the dBi value to "- -" (see chapter "Input data"). You will then measure in dBsv (absolute shock values) and get **no condition indication,** as the condition scale is graded in normalized shock values, dBn. This method is used for comparative readings on different bearings and/or other shock pulse sources.

The dBm/dBc technique



The dBm/dBc technique has been successfully applied for more than 35 years and continues to be widely used. It is well suited for industrial condition monitoring, because it works with few, easy to understand in- and output data.

Even on a logarithmic scale, there is normally a large, distinct difference between the maximum values from good and bad bearings. Thus, minor inaccuracies in the input data (rpm and shaft diameter) have little effect on the evaluated measuring result.

Lubrication condition is indicated by the delta value, i.e. the difference between dBm and dBc. High readings and a small delta value indicate poor lubrication or dry running. This is sufficient for maintenance purposes.

dBm and dBc are measured in a fixed time window and automatically displayed.

The headphone is used to listen to the shock pulse pattern in case of suspect or high readings. This, and the possibility to search for shock pulse sources with the probe transducer, are means to verify the measuring result and its cause.

Rules for measuring points

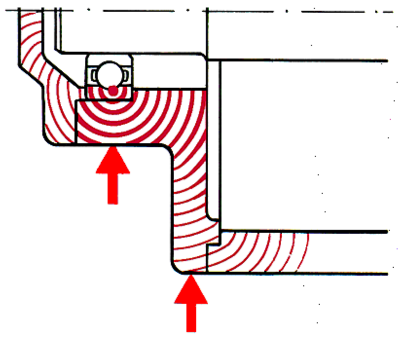
The rules for the selection of shock pulse measuring points have a very practical purpose. We are trying to capture low energy signals which are getting weaker the farther they travel and the more they are bounced about inside a piece of metal. We know that they lose strength when they cross over from one piece of metal to another. We cannot know, for all bearing applications, how much of the strength of the signal emitted by the bearing will reach the measuring point. However, by necessity we try to apply general evaluation rules, i. e. treat all measured signals as if they were of the same quality.

The rules for shock pulse measuring points try to assure that most of them are "within tolerance" and that the green-yellow-red condition zones are valid:

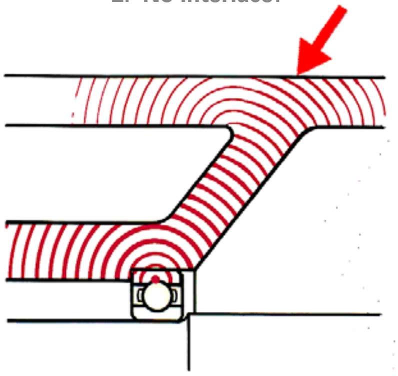
1. The signal path between bearing and measuring point shall be as short and straight as possible.
2. The signal path must contain only one mechanical interface: that between bearing and bearing housing.
3. The measuring point shall be located in the load zone of the bearing.

"Short" means up to 75 mm (3 in.), but that depends also on how straight the path is: bends cause re- and deflections whose effects are hard to judge. The load zone is the load carrying half of the bearing housing, normally the lower one. Allow for the pull of belts or other forces which can shift the load to one side. Use the probe to find the spot yielding the strongest signal. When a measuring point cannot conform to the rules (because an ideal spot cannot be reached), make allowance for a weaker signal.

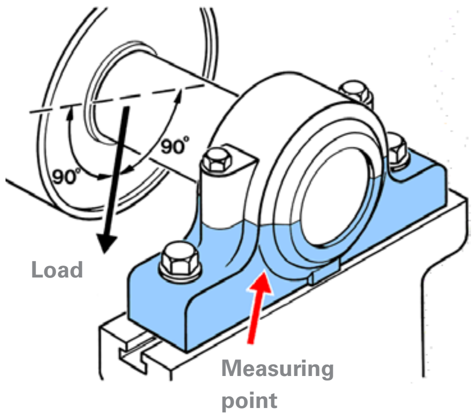
1. Straight and short path



2. No interface!



3. In the load zone of the bearing



Measuring points, examples

The following two pages show measuring points and possible adapter or transducer installations.

Through hole for long adapter

Figure A shows how a measuring point beneath a fan cover can be reached with a long adapter, through a hole in the cover.

Adapter with lock nut

In figure B, the fan cover is fastened directly to the motor shield, which is also the bearing housing. One of the cover's holding screws can be replaced by an adapter with lock nut.

Bearing housings beneath brackets

Consult machine drawings and identify the bearing housing before selecting a measuring point.

In figure C, showing a pump, the bearings are placed in two separate housings inside the bearing bracket.

The bearing pair at measuring point 1 can be reached with a long adapter through a clearance hole in the bracket. The hole must be large enough to allow bearing adjustment and still prevent metallic contact between bracket and adapter.

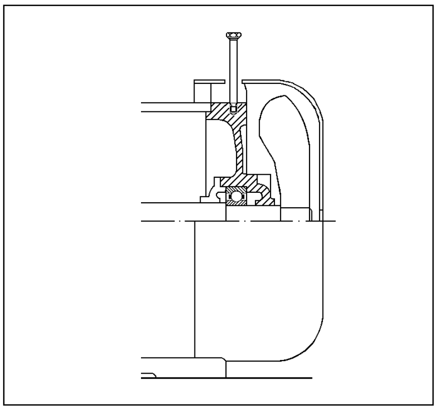
Measuring point 2, placed below and opposite to the pump outlet (load direction!) can be reached with a long adapter through an opening in the pump shield.

Multiple bearings in one housing

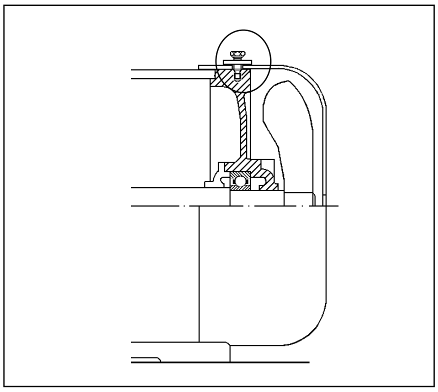
If there are several bearings in the same housing, they are normally treated as a single bearing. Figure D shows the bearing arrangement for a vertical pump. It is not possible to distinguish between the shock pulses from the paired bearings in point 1.

There is also a risk for cross talk between point 1 and point 2, which means that the shock pulses from the bearing in worst condition are picked up at both points. Check signal strength with the probe. Use one measuring point only if readings are identical in both points. This point (x) can be placed halfway between points 1 and 2.

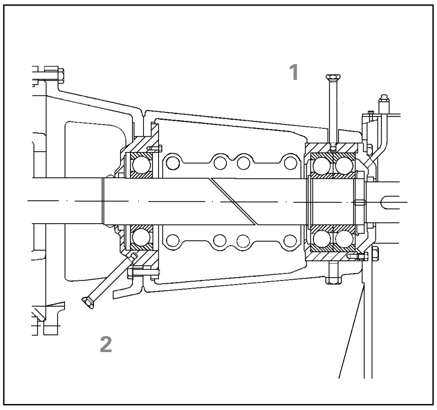
A



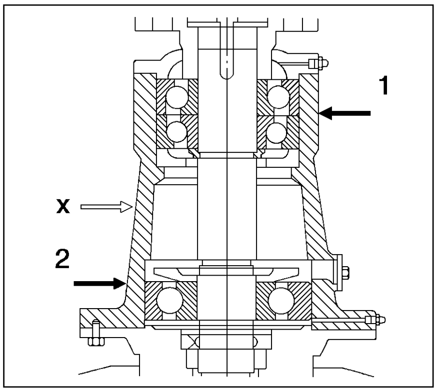
B



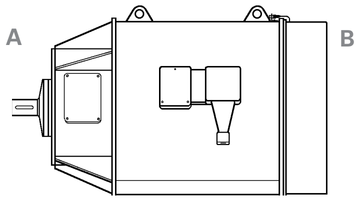
C



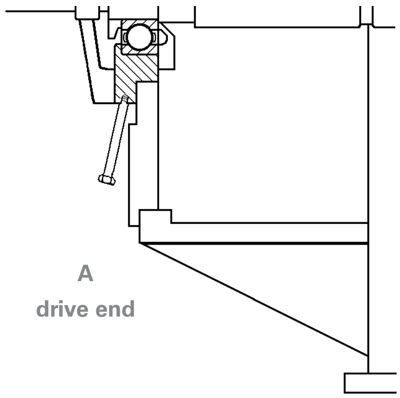
D



On large electric motors, the bearings are often mounted in housings which are welded or bolted to the motor shields. Because of the damping in the interface between the bushing and the shield, the measuring point should be on the bushing.



The bearing housing at the drive end (A) is usually within reach. A long adapter is installed at an angle to the shield, so that there is enough space for connecting the transducer.



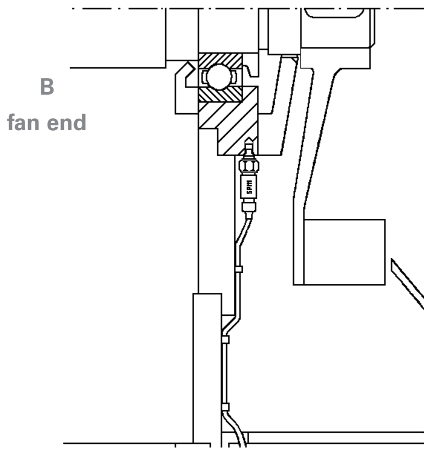
Installed transducer

The bearing at the fan end (B) requires a permanent transducer installation. The transducer is installed in the bushing. The coaxial cable is run through a slit in the fan cover to a measuring terminal on the stator frame.

Check installed equipment

Incorrectly installed adapters or transducers can cause a significant damping of the shock pulse signal.

Check all installations. Make sure that mounting holes are correctly countersunk and that the seat surfaces of adapters have good contact with the material of the bearing housings.



Any metallic machine part knocking or rubbing against the adapter will produce a disturbance. This must be avoided by making large clearance holes and using soft, elastic sealing material.

Use high temperature cables and moisture proof equipment where required, and protect installations against damage. Adapters should be fitted with protective caps.

Mark the measuring points

Measuring points for the probe transducer should be clearly marked. To get comparable readings, one must always use the same measuring point.

Measuring range

The measuring range of the bearing tester is large and covers most bearing applications, but there are a few cases where shock pulse monitoring should only be attempted with installed measuring equipment, or not at all.

High speed bearings: The bearing tester accepts max. 19 999 rpm, 1 999 mm shaft diameter, and a dBi of 40. The upper part of the table contains examples of possible combinations of shaft diameter and rpm giving a maximum dBi of 40. The lower part of the table exemplifies combinations that give dBi = 0. The instrument calculates the dBi up to 40. However, it is possible to manually set the dBi to max. 60. A reason for setting dbi > 40 is when measuring on e.g. turbo chargers, high speed gear boxes etc.

Low speed bearings: The lowest acceptable dBi is -9 dB. However, it is nearly impossible to get a meaningful reading from bearings in the extremely low speed ranges. The practical limit are bearings with a dBi around 0 dB (see lower half of the table).

A heavy load with a well defined direction and a low interference level make it easier to get readings from low speed bearings. Successful measurements has been carried out on bearings with dBi = –3 (54 rpm, shaft diameter 260 mm). Note that the dynamic measuring range decreases when dBi values get below 0. For example, a bearing with dBi = –3 showed very heavy damages at dBn = 40.

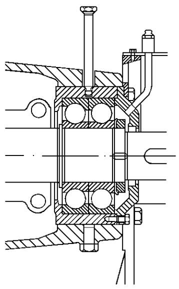
Installed adapters required: The installation of adapters is strongly recommended for all systematic shock pulse monitoring. In some cases it is a requirement:

- *on bearings with dBi below 5*
- *on heavily vibrating bearing housings*
- *on covered bearing housings.*

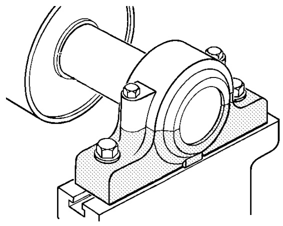
Low speed: Do not use a handheld probe on low speed bearings. As a rule, the measurement should cover at least 10 full revolutions of the shaft. A single damaged part in the raceway will cause a strong pulse only when hit by a rolling element while passing through the load zone. It can take several revolutions before that event occurs or is repeated.

Shaft, mm	rpm	dBi
50	19 999	40
100	13 000	40
180	10 000	40
300	6 000	40
500	5 000	40
1 000	3 400	40
1 999	2 200	40
1 999	24	0
1 000	35	0
650	45	0
500	52	0
300	72	0
180	100	0
100	140	0
50	210	0

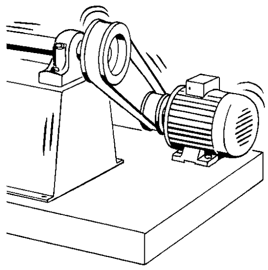
Adapters required!



Covered housing

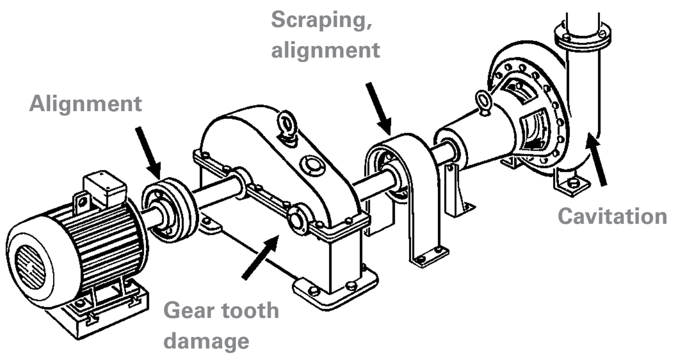


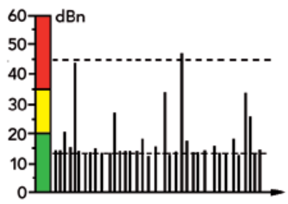
dBi < 5



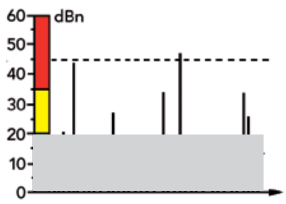
Heavy vibration

Creating acceptable measuring conditions

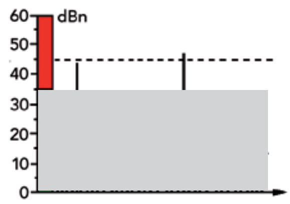




No interference



Low level interference



High level interference

The clicking of valves, high pressure steam flow, mechanical rubbing, damaged or badly adjusted gears, and load shocks from machine operation can cause a general high shock level on the machine frame. This interference can mask the bearing signal in cases where he shock level measured outside of the bearing housings is as high or higher than the shock level on the bearing housings.

Remove sources of interference

In most cases, interference is the result of bad machine condition. For example – cavitation in a pump is due to flow conditions for which the pump was not designed. Cavitation does more than interfere with bearing monitoring – it slowly erodes the material of the pump.

Monitoring the bearings is pointless if the machine breaks down or requires frequent repairs because of other poorly maintained parts or badly adjusted operating parameters. Therefore, do not accept interference – try to remove the cause.

Coping with interference

If the source of interference cannot be removed, there are several possibilities:

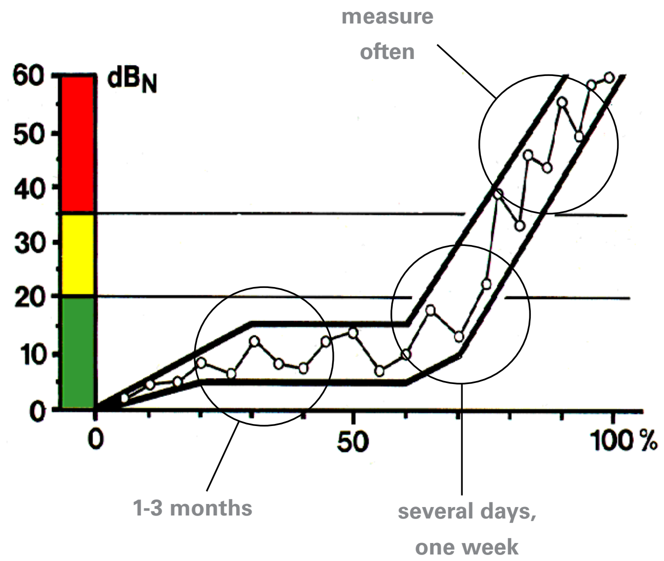
- *If it is intermittent, measure while there is no interference.*

If interference is persistent, measure its shock pulse level with the same dBi setting as the bearing and compare it with the condition zones:

- *If interference masks the green zone, you can get true bearing condition readings in the yellow and red zone.*
- *If interference masks the yellow zone, you can get true bearing condition readings in the red zone, i.e. find a damaged bearing.*

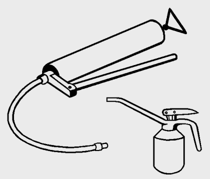
If the interference level is persistently higher than the shock level that would be caused by bad bearing condition (35 to 40 dB above the dBi), do not try to monitor the bearing.

Measuring intervals



Measuring personnel should know about:

- lubricant type
- maximum quantity
- lubricating intervals



Unpredicted, very rapid damage development is rare. Normally, surface damage develops slowly, over a period of many months. These are the general guidelines for selecting the interval between periodic readings:

- *The bearings should be checked at least once every three months.*
- *The bearings in critical machinery and heavily preloaded bearings (e.g. spindle bearings) should be measured more often than other bearings.*
- The bearings should be measured more frequently when their condition is unstable (rising or irregular readings).
- *Damaged bearings should be closely watched until they can be replaced.*

This implies that one has to allow time for extra checks on bearings in dubious or bad condition.

Check stand-by equipment

Vibration and corrosion can damage the bearings in stand-by machines. Check bearing condition each time such machines are being tested or used.

Synchronize with lubrication

It may be necessary to synchronize regreasing and measuring intervals. Grease lubricated bearings should not be measured until they have run for approximately one hour after regreasing (except when doing a lubrication test).

Keep in mind that bad bearing condition is often connected with lubrication problems. For grease lubricated bearings, a lubrication test usually provides the final proof of bearing damage. Make sure that the right type and quantity of grease is used.

Shock pulse transducers

Built-in transducer with probe

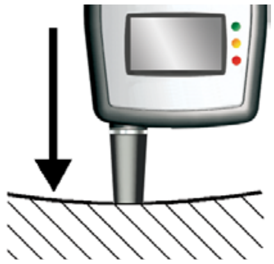
Measuring points for the built-in probe should be clearly marked. Always measure in the same spot. In addition, the probe is used to measure elsewhere on the machine, in case it is necessary to search for other shock pulse sources such as pump cavitation or rubbing parts.

The probe tip is spring loaded and moves within a sleeve of hard rubber. To maintain a steady pressure on the tip, press the probe tip against the measuring point until the rubber sleeve is in contact with the surface.

Hold the probe steady to avoid rubbing between probe tip and surface.

The probe is directionally sensitive. It has to be pointed straight at the bearing.

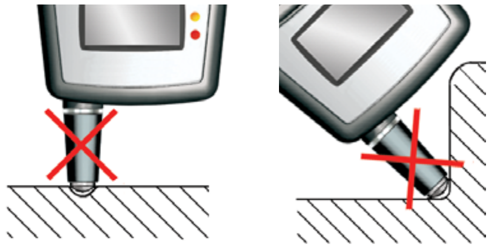
The centre of the probe tip should touch the surface. Avoid pressing the probe tip against cavities and fillets which are smaller than the probe tip.



Rubber sleeve in contact with the surface

Point at the bearing

Hold steady



Avoid small cavities and fillets

Shock pulse transducer with handheld probe

The handheld probe can be used to reach measuring points in narrow spaces and has the same construction and method of operation as the built-in transducer (see above).

The only part likely to wear out is the rubber sleeve for the probe tip. It is made of chloroprene rubber (neoprene) and tolerates 110° C (230° F). Spare sleeves have part number 13108.

Transducer with probe TRA73T

Transducer with quick connector

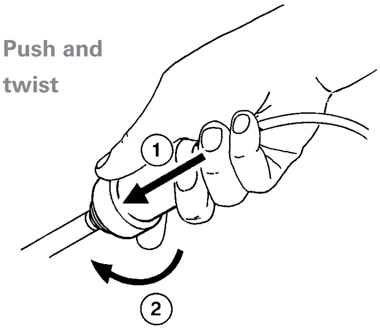
All types of shock pulse transducers are connected to the transducer input (8). The choice of transducer type depends on how the measuring point is prepared. For systematic shock pulse monitoring, Timken recommends the use of permanently installed adapters and quick-connect transducer wherever possible.

TRA74T

Adapters are solid metal bolts of different length and thread sizes, tuned for correct signal transmission. They are installed in threaded, countersunk mounting holes on the bearing housings. Glue-on adapters are available.

Standard adapter

To attach the transducer with quick connector, press it against the adapter and twist clockwise. Twist counter-clockwise to remove it.



Push and twist

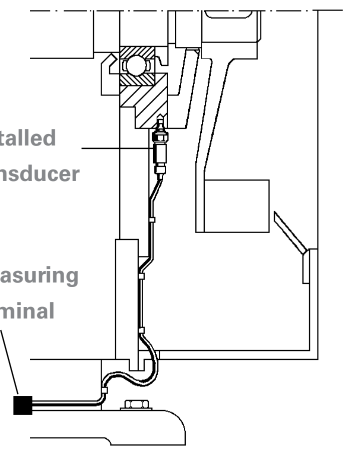
Adapter surfaces must be clean and plane. Use an adapter cap to protect them.

Check that installed transducers and adapters are properly mounted and in good condition. You cannot expect a useful signal by attaching the quick connect transducer to a rusty lump of metal, or from a transducer that is rolling on the floor on the other side of a partition.

Permanently installed transducers and measuring terminal

Standard transducer

A permanently installed transducer and a measuring terminal (BNC or TNC connector) are used when the bearing cannot be reached directly. Use a measuring cable to connect instrument and terminal. Use dust caps to protect the connector.



Installed transducer

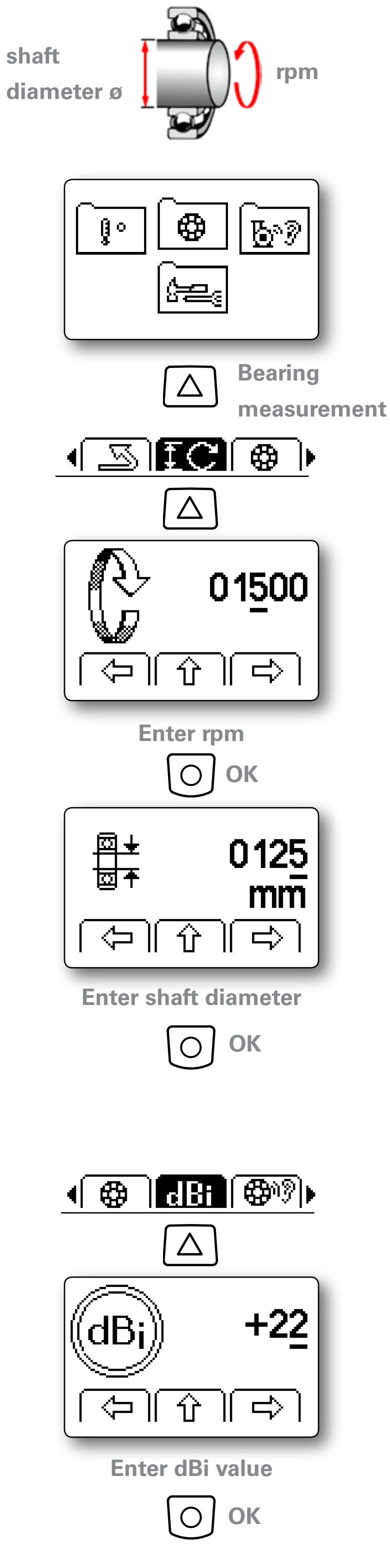
Measuring terminal

Check that installed transducers and adapters are properly mounted and in good condition. You cannot expect a useful signal by attaching the quick connect transducer to a rusty lump of metal, or from a transducer that is rolling on the floor on the other side of a partition.

Bearing Measurement

Input data

For a reading of bearing condition with bearing tester, you need the initial value, dBi. If you do not know the bearing's dBi, bearing tester will calculate and display the dBi given the rotational speed (rpm) and the shaft diameter. **Neglecting to enter this information will produce incorrect measurement results.**



Entering shaft diameter and rpm for dBi calculation

From the **Main** display, press the UP arrow key to enter **Bearing** mode. Use LEFT/RIGHT arrow keys to highlight the **Input Data** icon, then press the UP arrow key. Use the LEFT/RIGHT arrow keys to position the cursor and the UP/DOWN arrow keys to increase or decrease the rpm value, respectively. To enter the shaft diameter, first press the measuring key, then use the arrow keys to set the diameter value the same way rpm was set.

Press the measuring key to return to **Bearing** mode.

Entering dBi manually

Changing the dBi directly is faster when you know it from your records:

From the **Main** display, press the UP arrow key to enter **Bearing** mode. Use LEFT/RIGHT arrow keys to highlight the **dBi** icon, then press the UP arrow key. First, position the cursor using the LEFT/RIGHT arrow keys, then use the UP/DOWN arrow keys to increase or decrease the dBi value, respectively.

The highest dBi value that can be entered is +60, the lowest -9. Any attempt to enter values below this results in dBi = "- -" and an unnormalized shock pulse reading (see also chapters "Normalized shock pulse values with dBi" and "Readings on gearboxes"). To set the dBi value back from "- -" to "+" or "-", press the UP arrow key, then position the cursor as required to set the dBi.

Press the measuring key to return to **Bearing** mode.

The dBi value, whether calculated by the instrument or manually input, is shown in the lower right part of the **Bearing** display.

Shock pulse measurement

For shock pulse measurement, press the UP arrow key in the **Main** display to enter the **Bearing** display. **Make sure the shaft diameter and rotational speed of the bearing, or its dBi, have been entered** (see chapter Input data), or the reading will be incorrect**.**

From the **Bearing** display, press the transducer to the measuring point. Measurement starts automatically, taking a few seconds, during which the blue measuring LED is lit up.

The two measuring results are the maximum value, dBm, and the carpet value, dBc. Depending on the dBm value, the green, yellow or red light LED to the left of the display will light up.

When an external transducer is used, the instrument will display a TLT warning sign if the transducer line test result is unsatisfactory. For further information about TLT, please see chapter "Transducer Line Test".

When measurement is finished, the LED indicators show the bearing condition, and an evaluation code is displayed. The code refers to the Evaluation Flow Chart on page 32-33, which must be used to further evaluate the bearing condition.

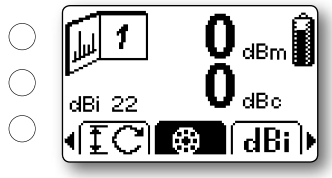
When you get high readings (yellow and red zone), you should immediately verify their nature and probable cause. Do not give the verdict "bearing damage" before making a further investigation. As a first measure:

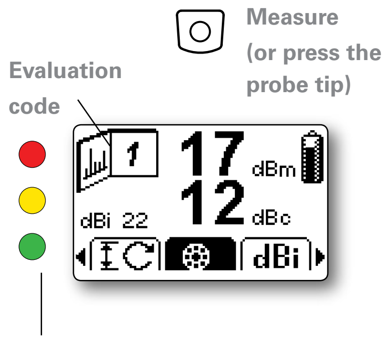
- *use the headphones to identify the shock pulse pattern.*
- *measure on and outside of the bearing housing to identify the shock pulse source.*

Surface temperature is measured automatically when a shock pulse measurement is made. To see the temperature reading, use LEFT/RIGHT arrow keys to activate the **Return** icon in the **Bearing** display, then press the UP arrow key to enter the **Main** display. Press the LEFT arrow key to enter **Temperature** mode and see the reading. To return to the **Main** display, press the LEFT arrow key.

Check:
- **Shaft diameter and rpm, dBi setting**
- **Measuring point in the load zone**
- **Probe pointed straight at the bearing**
- **Adapter (transducer) properly mounted**
- **Adapter surface clean, undamaged**
- **Quick connect transducer firmly attached**

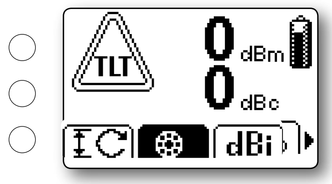
Bearing measurement





Condition indicators:
red - bad (≥35)
yellow - caution (21–34)
green - good (≤ 20)

TLT warning



Transducer Line Test

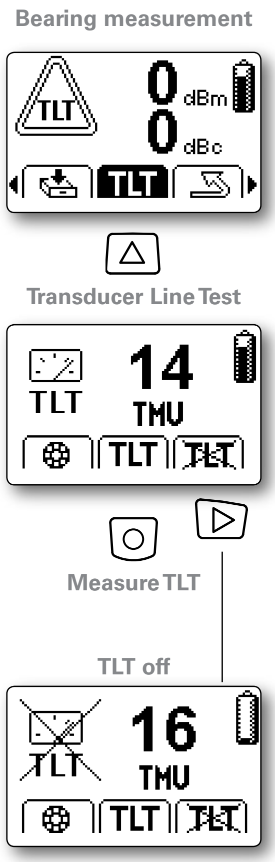
When measuring shock pulses with external transducers, a transducer line test (TLT) will automatically be made to check the quality of the signal transmission between transducer and instrument (to see the TLT value, enter the **TLT** mode, see below). Part of your signal will be lost in a poor transducer line, so your measuring results will be lower than they should be. If an shock pulse measurement is made with a poor transducer line, the instrument will display a TLT warning sign.

To perform a transducer line test (TLT) manually, connect the external transducer to the instrument. From the **Main** display, press the UP arrow key to enter the **Bearing** folder, then use LEFT/RIGHT arrow keys to highlight the **TLT** icon. Press the UP arrow key to enter the **TLT** menu. Press the measuring key briefly. The blue measuring LED lights up and the reading is shown in the display.

The TLT test window also displays transducer type: **IPR** (internal probe), **EPR** (external probe), **TRA** (40000 type) or **TMU** (42000 type). **TRA** is also displayed in case of a cable breakdown. The TLT value then depends on the distance to the breakage point (1-2 dB/meter). In case of a short-circuit, **TMU** and the value 0 (normally) is displayed.

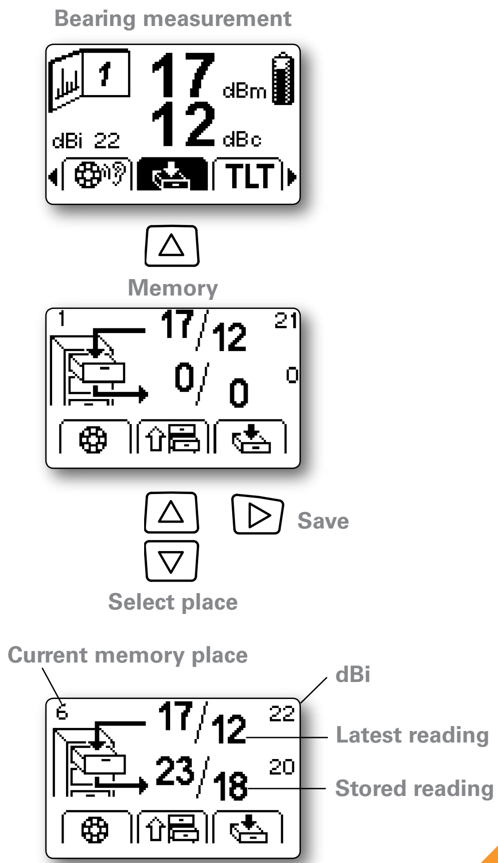
At TLT values from 15 upward, there is normally no signal loss due to poor transmission between transducer and instrument. If the value is below 15, or if it is deteriorating from a previously higher value, you need to check cables, connectors and transducers for poor connections and moisture.

The TLT test can be temporarily turned off to force evaluated measurement results on transducers with TLT below 15, e.g. when measuring via coupling transformers. In the **TLT** menu, press the RIGHT arrow key to turn the test off. The TLT test is automatically turned back on by entering the **TLT** menu again and when the instrument is automatically or manually turned off.



Storing measurement results

This function is useful for easy comparison of measurement results for a particular measuring point. It can also be used to store measurement results temporarily until they can be recorded on paper for trending and follow-up. On the last page of the User Guide is a follow-up form which can be copied and used for this purpose.



The bearing tester can store up to ten measuring results.

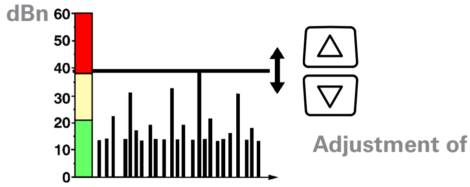
In the **Bearing** display, use LEFT/RIGHT arrow keys to highlight the **Memory** icon, then press the UP arrow key to enter **Memory** mode. Select memory place (1-10) by using the UP/DOWN arrow keys. Press the RIGHT arrow key to store the reading. This action will overwrite any previously stored value in the memory place selected.

To return to the **Bearing** display, press the LEFT arrow key.

Listening to the shock pulse pattern

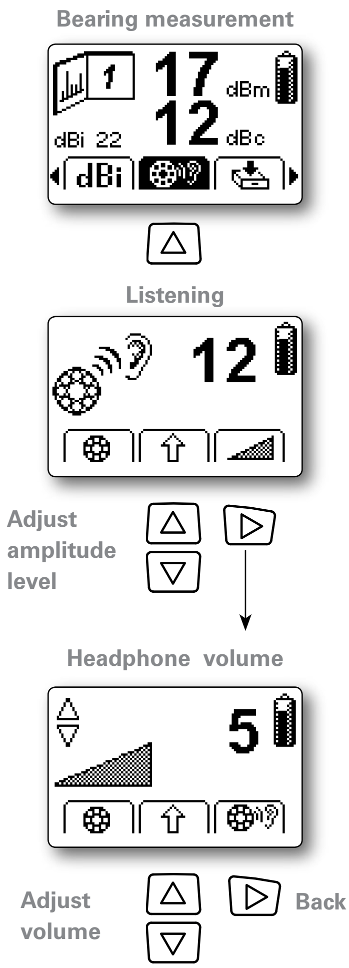
The stream of shock pulses from a rotating bearing is continuous. They vary in strength, depending on the relative positions of rolling elements and raceways.

The **headphone** is a means to verify and trace shock pulse sources. The headphones allow you to listen to the shock pulse pattern. In the headphone, the noise carpet is represented by a continuous tone. The dBc level is approximately where you can start to distinguish between an even sound and individual pulses. Typical for bearing signals is a random sequence of strong pulses with no discernible rhythm, best heard a few dB below the dBm level.



A spot of surface damage causing a strong shock pulse will only register, if a roller hits it during the measuring interval. Especially at low rotational speeds, the instrument can miss the strongest pulse, simply because it does not occur during the measuring interval.

To listen to the shock pulse pattern after taking a reading, connect your headphones to the output connector (7). From the **Main** display, press the UP arrow key to enter **Bearing** mode. Use the LEFT/RIGHT arrow keys to highlight the **Listening** icon, then press the UP arrow key to enter listening mode, where the dBm value of the latest reading is displayed. Use the UP/DOWN arrow keys to adjust the amplitude level at which you wish to listen; anything below this value will be filtered out.

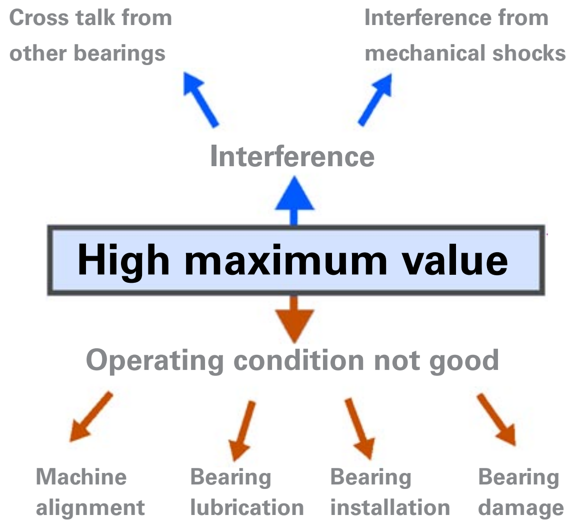


To adjust the headphone volume use the RIGHT arrow key.

NOTE
Setting the volume to the maximum level may harm your hearing.

To return to the **Bearing** display, press the LEFT arrow key.

Evaluating the Bearing Condition



1. **Reading correct? Check!**
   Measuring point? Installation? Correct dBi? dBm?
   Look, feel, check data.

2. **Shock pulse source? Search!**
   Bearing? Interference? Signal pattern? Loose parts?
   Look, listen. Use probe transducer, headphone.

3. **Bearing fault? Analyze!**
   Lubrication? Alignment? Installation?
   Bearing damage?

   Identify shock pulse pattern.
   Check trend. Test lubrication.

NOTE
A reading taken with an incorrect dBi value causes an incorrect evaluation of the bearing condition! Always check that the correct dBi for the bearing in question has been entered!

Evaluation simply means that you make sure that the information you pass on to the maintenance personnel is as correct as possible and as detailed as necessary. Always remember that

- *some machines can contain many types of shock pulse sources other than the bearing, and*
- *there can be a number of different causes for bad bearing condition other than damage.*

Evaluation requires only normal care and common sense. Use the probe transducer and the headphone, and also use your senses: look, touch, listen. By being thorough you can avoid raising false alarms or missing damaged bearings.

Initial readings and changes

There are only two situations where an evaluation is necessary. The first is when you start with bearing monitoring:

- *Always evaluate the first readings on new measuring points and newly installed bearings.*

The purpose is to establish a reliable base for routine measurements. You want to be quite sure that you are measuring shock pulses from the bearing and that the reading itself is correct. If you find that bearing condition is good, you do not have to evaluate the following readings on that measuring point as long as there is no significant change.

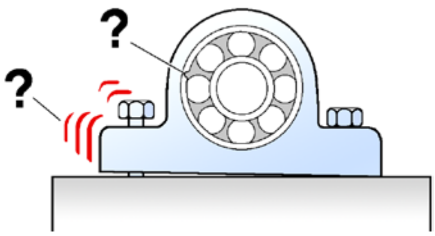
The other situation is when you notice a change in the readings (or get high readings from the start):

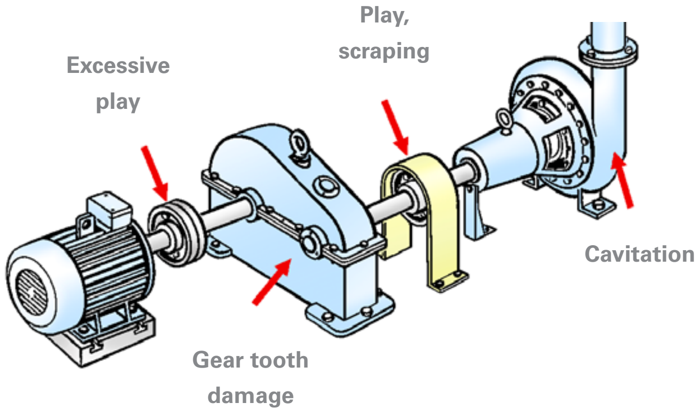
- *Investigate any significant increase or decrease of the shock pulse level.*

Again, you want to be quite sure that you are measuring shock pulses from the bearing and that the reading itself is correct.

If you find that bearing condition is not good, you have to distinguish between bad installation, poor lubrication, overload and damage, in order to decide what kind of maintenance work is needed. If you are getting an interference signal, it is probably caused by machine faults which have to be reported and repaired.

Identifying the shock pulse source





Shock pulses are strongest close to the source. They spread through the material of all machine parts, but are dampened (loss of signal) with distance and when passing through interfaces in the material.

- *Measure on and near the bearing housing to find the strongest shock pulse source.*
- *Listen for unusual noises.*

Sources of interference

Any kind of metallic clatter, hard impacts or scraping produces shock pulses which may interfere with the measurement on the bearings. Some of the more common sources of interference are:

- *Shocks between poorly fastened machine feet and foundation.*
- *Rubbing between shafts and other machine parts.*
- *Loose parts striking the machine frame or the bearing housing.*
- *Excessive play and misalignment of couplings.*
- *Vibration in connection with loose parts and excessive bearing play (vibration alone does not affect the reading).*
- *Cavitation in pumps.*
- *Gear tooth damage.*
- *Load and pressure shocks arising during the normal operation of certain machines.*

Shock pulse patterns – condition codes

The headphone is a means to verify and trace shock pulse sources. The signal from a bearing should be highest on the bearing housing. If you get a higher signal outside of the bearing housing (across an interface in the material), you are most likely measuring shock pulses from another bearing or some other source. Typical for bearing signals is that the stronger shock pulses, best heard a few dB below the peak level, appear at random intervals.

The codes refer to the Evaluation Guide, or the Flow Chart on page 32-33, which must be used to further evaluate the bearing condition.

If instrument displays **"2/3"** or **"4/5",** use the headphones to determine the condition code.

1. For a good bearing, the dBm is within the green zone. dBm and dBc are close together.

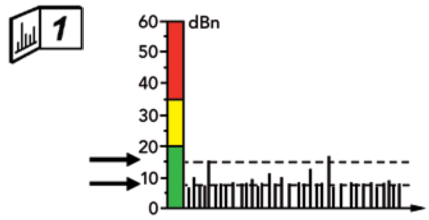
2. The shock pulse pattern from a damaged bearing contains strong pulses in the red zone, a random sequence, and a large difference between dBm and dBc. When you lubricate the bearing, the values should drop but rise again.

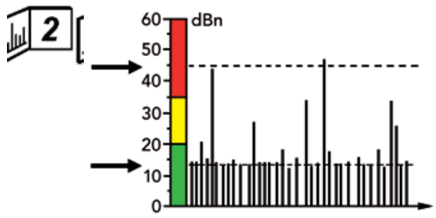
3. A dry running bearing has a high carpet value very close to the dBm. When you lubricate the bearing, the values should drop and stay low. A similar pattern is caused by pump cavitation, in which case readings on the pump housing are stronger than those taken on the bearing housing, and are not influenced by lubricating the bearing.

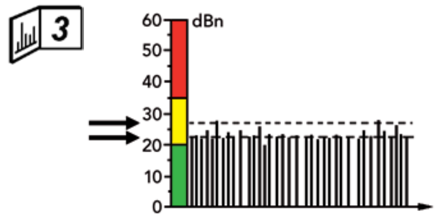
4. A regular pattern, containing bursts of strong pulses in a rhythmic sequence, is caused by e.g. scraping parts.

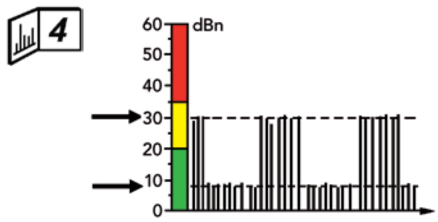
5. Individual pulses in a regular sequence are cause by clicking valves, knocking parts, regular load shocks.

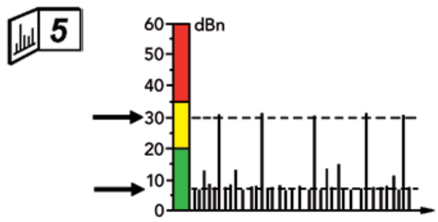
6. A sudden drop in the shock pulse level is suspicious. Check your measuring equipment. If the reading is correct, you may have a slipping bearing ring.

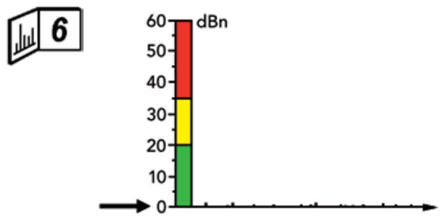








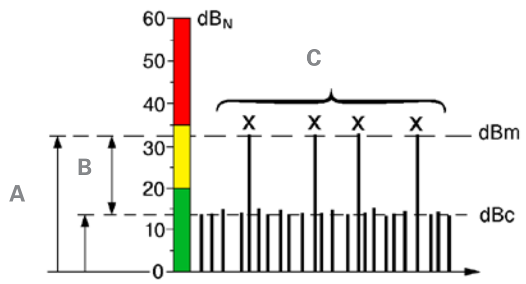




Typical shock pulse patterns from rolling bearings

A shock pulse pattern is a sequence of either random or rhythmical strong pulses (dBm level) above a carpet of very rapid weaker pulses (dBc level). You have to be aware of:

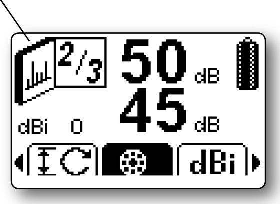
- *the dBm value*
- *the difference between dBm and dBc*
- *the rhythm of the strongest pulses.*



A) Maximum value dBm
B) Difference between dBm and dBc
C) Rhythm of the strongest pulses

The rhythm of the strongest pulses is best discerned by listening with the headphone at a setting a few dB below the dBm level. Typical for bearing signals is a **random** sequence of strong pulses (no discernible rhythm). Rhythmical shocks can come from a bearing but are more often a sign of interference. Typical patterns are described on the next pages.

Evaluation code

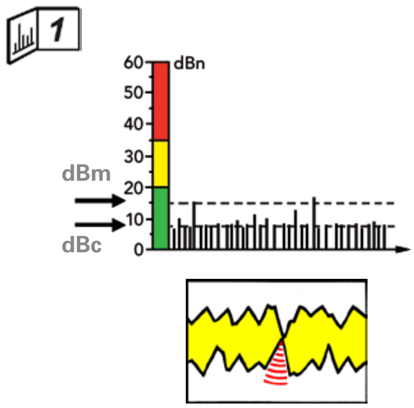


The bearing tester recognizes the pattern of the reading taken and determines which of the six patterns below is a match. The matching number is displayed in the upper left corner of the Bearing display when the measurement is completed. This number corresponds to the pattern numbers below.

There may be times when the instrument displays a combination of the numbers **"2/3"** or **"4/5",** in which case the instrument can not distinguish between the two codes. Use the headphones and listen to the pattern to determine condition code.

1. Pattern from a good bearing

A bearing in good condition should have a dBm value below 20 and a dBc value approximately 5 to 10 dB lower. Once you have verified the reading, there is no need for any further evaluation.

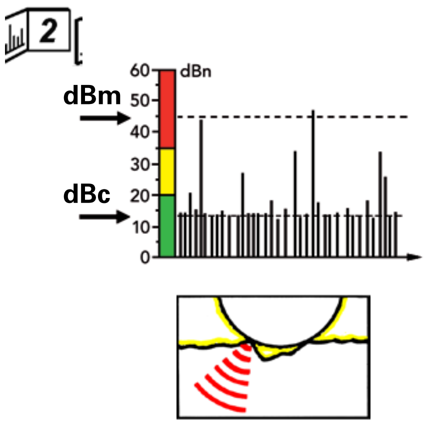


The maximum value can be lower than 0. However, be suspicious when the measured value is very low. The cause is often a bad measuring point or an incorrectly installed adapter or transducer. If the reading is very low, check the installation. Measure on other parts of the bearing housing and try to pick up a stronger signal. Another possible reason for a very low reading is that there is no load on the bearing. This can happen with well balanced fans and similar rotating machines.

2. Signal from a damaged bearing

The pattern shown is typical for damaged bearing surfaces: a dBm above 35 dB, a large gap between dBm and dBc, and a **random** pattern of strong pulses. The strength of the maximum value dBm indicates the degree of damage:

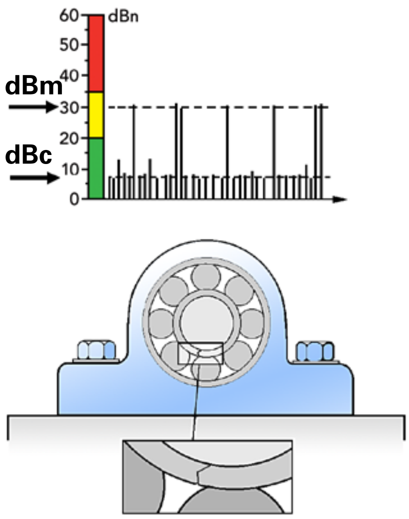
35 – 40 dB_N	Slight damage
40 – 45 dB_N	Severe damage
> 45 dB_N	High breakdown risk.



First signs of damage

dBm values between 20 and 35 dB (in the yellow zone) and a moderate increase of the carpet value are a sign of stress in the bearing surfaces or minor damage. Note that the gap between dBm and dBc gets larger.

Bearings with dBm values in the yellow zone should be measured more frequently, to determine if their condition is stable or deteriorating.



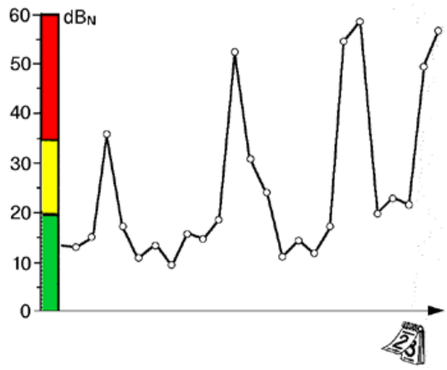
NOTE
A similar pattern is caused by contaminations in the lubricant (metal or dirt). The particles either originate from parts of the bearing itself, for instance from a damaged cage, or they are transported by the lubricant into the (undamaged) bearing. Test bearing and lubricant according to the description "Confirming bearing damage" in this manual.

Cracked inner ring

A clean crack in the inner ring of a bearing is difficult to detect, especially at a low rpm. You may get low readings through most of the bearing's rotation, then one or two peaks while the crack is in the load zone. Signal strength can differ considerably as the crack opens or closes depending on bearing temperature. In time, the surface tends to spall along the crack, leaving sharp edges and metal particles which cause high shock values until they are rolled out.

Irregular measuring results

Large variations between consecutive readings are a danger sign. Damaged bearings do not improve with time, although their shock values may temporarily drop.



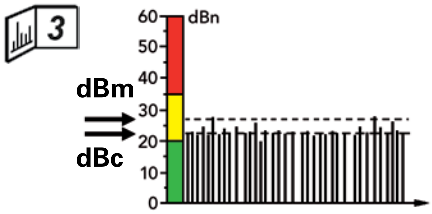
Make sure the measuring interval is established according the variations in production load (e.g. air compressors). Always measure under the same production conditions.

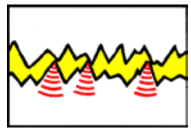
Wide variations in the readings taken at different times can occur on heavily loaded roller bearings with surface damage. The high readings are caused by metal particles breaking off the surfaces and by the sharp edges of new spallings. When particles and edges are rolled out, the readings will drop again.

3. Patterns from poorly lubricated bearings

A high carpet value, very close to the maximum value, is typical for dry running bearings. The dBm does not always reach the red zone – typical for poor lubrication is that the gap between dBm and dBc is very small. If the signal is strongest on the bearing housing, it can have several causes:

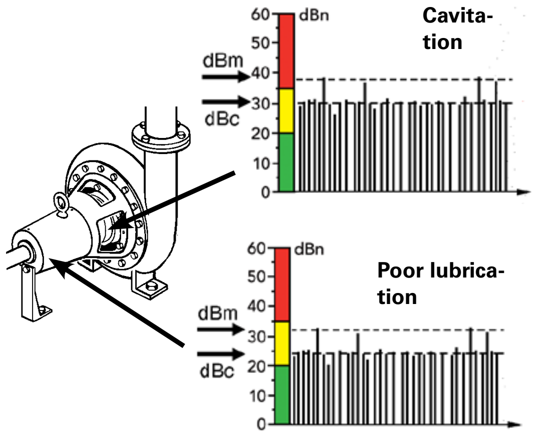
- *insufficient lubricant supply to the bearing (poor oil flow; old , caked, or cold grease)*
- *very low or very high bearing speed (preventing the build-up of an oil film separation between the loaded rolling elements and the raceway)*
- *installation fault (excessive preload) or out-of-round bearing housing*
- *misalignment or bent shaft.*





If possible, lubricate the bearing or increase the oil flow. Measure immediately afterwards, and again a few hours later. If the problem was insufficient lubricant supply, the shock pulse level should drop and stay low.

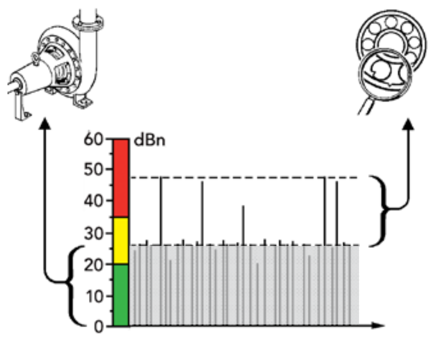
In the case of very low or very high bearing speed, one can try lubricants of a different viscosity or use additives to prevent metal to metal contact between the bearing surfaces.



In cases of installation faults, unround housings, and misalignment) the shock pulse level may drop after lubrication but will soon rise again. Misalignment normally affects the bearings on both sides of the coupling or at both ends of the shaft.

Cavitation and similar interference

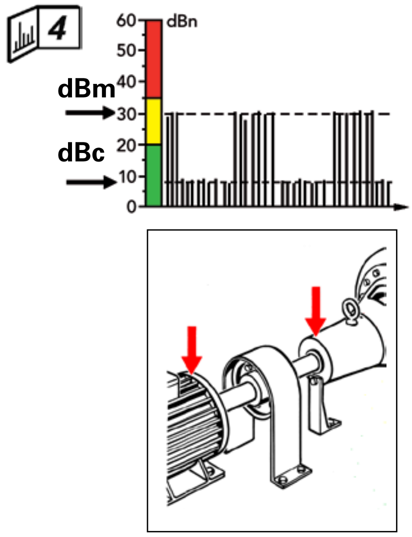
The shock pulse pattern caused by a cavitating pump or by persistent rubbing is identical with that from a dry running bearing. You have an interference signal when the shock pulse level is highest outside of the bearing housing and is not affected by lubricating the bearing.



If you cannot remove the cause of interference, you have a "blind spot": up to a certain level, the interference signal will mask the signal from one or more bearings. However, you may still be able to detect bearing damage. When the dBm rises above the interference level, it must be caused by something else – probably bad bearing condition. In that case, lubricating the bearing should cause the value to drop, at least temporarily.

4. Periodic bursts

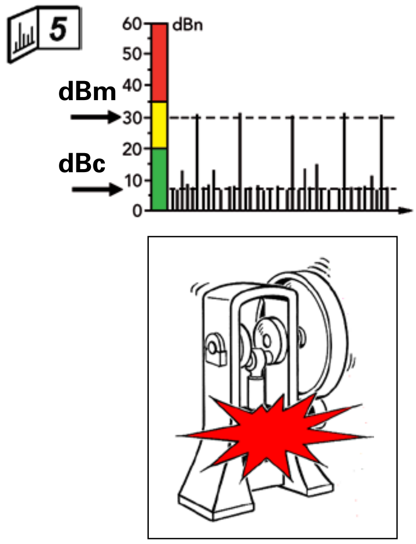
Periodic bursts are a typical interference signal, caused by rubbing between machine parts, e.g. shaft against bearing housing or seal. The burst occurs at an rpm related frequency.



5. Rhythmical peaks

Single, rhythmical peaks can be caused by load and pressure shocks which occur during the machine's normal operation. Other possible causes are clicking valves or loose parts knocking regularly against the machine frame.

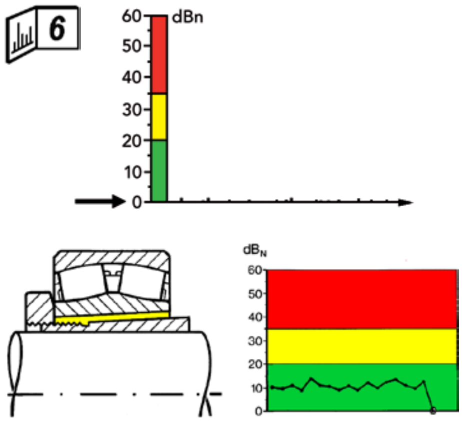
If the signal is strongest on the bearing housing, you can suspect a cracked inner ring.



6. Large drop in the readings

If the shock pulse level drops after a sequence of normal readings, you have either a malfunction of the instrument, a failure in a transducer installation, or a serious bearing fault.

Check the instrument by measuring on some other bearing. In case of an installed transducer, try to get a reading by tapping on the bearing housing. If your reading is correct, it is possible that one of the bearing races is slipping, either on the shaft or in the housing. In case of a heavily loaded bearing with previous readings in the red zone, suspect cage failure.

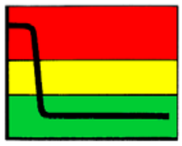


Confirming bearing damage

On receiving the typical bearing damage signal – high dBm, large difference between dBm and dBc, random peaks, strongest signal on the bearing housing – you must confirm one of the following causes for the reading:

- *tapping of loose parts against the bearing housing*
- *excessive bearing play in combination with vibration*
- *particles in the lubricant*
- *bearing damage.*

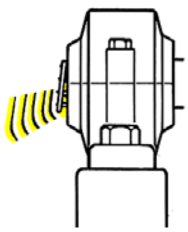
Interference can usually be detected by a careful inspection.



Lubrication test
A lubrication test is the best means to reach a conclusive verdict:

- *Make sure that the lubricant is clean and not contaminated.*
- *Lubricate the bearing and repeat the measurement. Measure immediately after lubricating and again a few hours later.*

Make sure that the lubricant reaches the bearing. Typically, you will get the following results:



A. The shock pulse level remains constant. The signal is caused by interference or cross talk from another bearing.

B. The shock pulse level drops immediately after lubricating and remains low. Foreign particles in the bearing were removed by the fresh lubricant.

C. The shock pulse level drops immediately after lubricating but rises again within a few hours. The bearing is damaged.

Note that metal particles in the lubricant can originate from the bearing itself. Measure the bearing again over the next few days and make sure that the values stay low.

Readings on gear boxes

Shock pulses can sometimes spread through a machine housing without significant damping. This means that the shock pulses from the bearing with the highest shock pulse level can, under unfavorable circumstances, interfere with the readings on all the other bearings.

The problem is aggravated when the bearings are of different sizes and rotating at different speeds, as in a gear box. A bearing with high rotational speed has a high dBi value and generates relatively strong pulses even when its operating condition is good. The same shock pulse level measured on a bearing with a low dBi may indicate bad bearing condition.

In such cases, you must proceed as follows:

1. Take a reading with dBi set to "--" on all bearings. This will reveal the strongest shock pulse source on the machine. In the example in the figure, you get a reading of 53 dBsv for bearing A and 47 dBsv for bearing B.

NOTE
When taking readings with dBi set to "--" the evaluation in green - yellow- red does not apply!

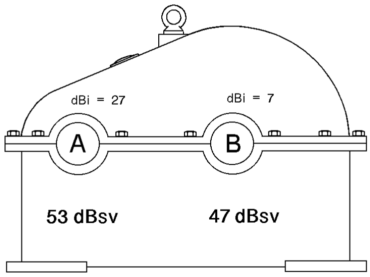
See also chapters "Normalized shock pulse values with dBi" and "Input data".

2. Work out the direction of possible cross talk. You know that the stronger source can mask the signal of the weaker source. In this case, cross talk must go from bearing A to bearing B.

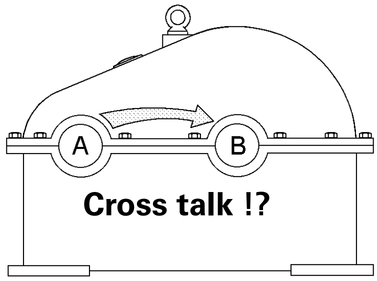
3. Subtract the dBi values from the dBsv values. In the example, you get 26 dB_N for bearing A, 40 dB_N for bearing B.

You can now draw two conclusions: The reading for bearing A, coming from the stronger source, is probably accurate. The bearing condition is reduced (26 dB = yellow zone) but not seriously so.

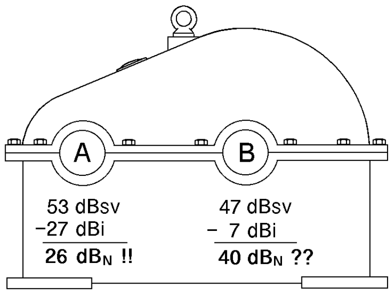
The reading from bearing B is either true or false. If true, it indicates bad bearing condition (40 dB = red zone), but you cannot confirm that with the instrument before condition gets worse and bearing B becomes the stronger shock pulse source. Your solution is to take frequent readings and compare the results from both bearings.



1. **Readings with dBi = "--" reveal the stronger source**



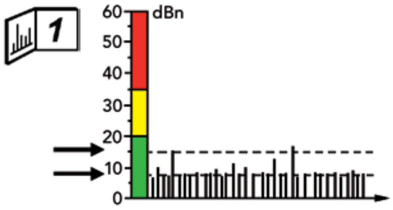
2. **Cross talk must go from the stronger to the weaker source**



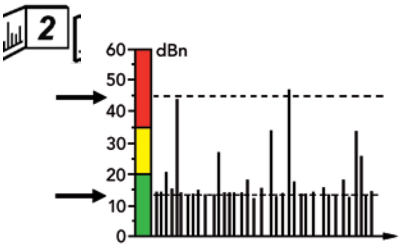
3. **The reading from the stronger source is normally accurate**

The reading from the weaker source cannot be confirmed

Evaluation flow chart



Good bearing condition, installation and lubrication.



Where do you get the highest reading?

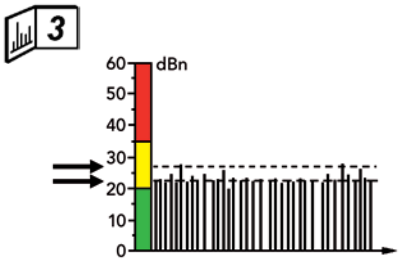
Adjacent to the bearing housing

Locate the signal source. The reading can be caused by cross talk from other defective bearings or disturbances from other mechanical shocks. If possible, isolate the source of disturbance and test again.

On the bearing housing

Check the value of adjacent bearings.

Are the signals from these bearings similar to the tested bearing?



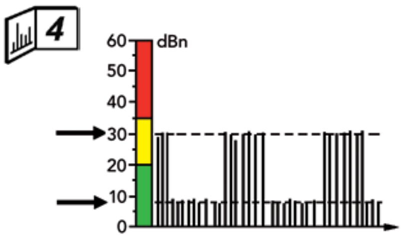
Where do you get the highest reading?

Adjacent to the bearing housing

Locate the signal source. The reading can be caused by interference from other defective bearings, cavitation in pumps or mechanical rubbing. If possible, isolate the source of disturbance and test again.

On the bearing housing

Newly installed bearing?



Where do you get the highest reading?

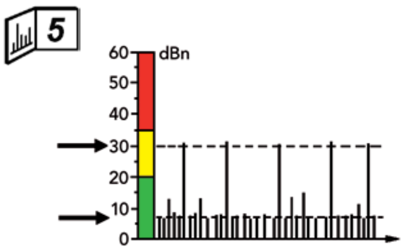
Adjacent to the bearing housing

Locate the signal source. If possible, isolate the source of disturbance and test again.

On the bearing housing

Probable causes:

- The shaft rubs against the bearing housing or the end of the shaft rubs against the bearing cap.
- Gear tooth damage
- Other mechanical rubbing



Where do you get the highest reading?

Adjacent to the bearing housing

Locate the signal source.

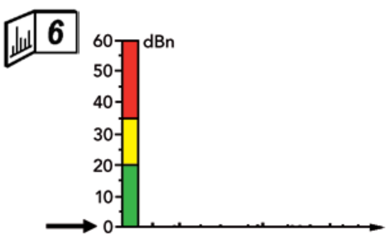
Probable causes:

- Load or pressure shocks from equipment installed on the machine frame.
- Other mechanical shocks from the machine's operation. If possible, isolate the source of disturbance and test again.

On the bearing housing

Probable causes:

- Load or pressure shocks in the machine's operation causing mechanical shocks in the bearing.
- Individual gear tooth damage
- Bearing damage



No signal or only a very low value can be obtained.

No

Probable causes:

- Bearing damage. Measure in shorter in-tervals, follow the progress of the damage .
- Foreign particles in the lubricant. Can also be caused by disturbance from loose bearing cap, protecting cover or similar items.

If possible, isolate the source of disturbance and test again.

If possible, lubricate the bearing and check the reading at the same time.

When lubricating, check that the lubricant penetrates into the bearing.

The reading drops but increases again within a few hours.

Cause: bearing damage.

Shorten measuring intervals to follow the progress of the damage.

The reading drops to normal level and does not increase again. Cause: foreign particles in the bearing which have been removed by the new lubricant.

The reading does not drop.

Probable causes: disturbances from loose bearing cap, pro-tecting cover or similar items.

Can also be caused by: Large bearing damage.

Yes

Probable causes: axial shocks, load shocks, defective shaft coupling, gear tooth damage, cross talk from other defective bearings.

No

Probable causes:

- Insufficient lubrication, possibly in combination with minor bearing damage
- Cavitation in pumps
- Mechanical rubbing
- Gear tooth damage

If possible, lubricate the bearing and check the reading at the same time.

When lubricating, check that the lubri-cant penetrates into the bearing.

The reading drops but the max. value increases again within a few hours.

Probable causes: insufficient lubrication which probably has caused minor bearing damage.

The reading drops to normal level and does not increase again. Cause: insufficient lubrication.

The reading does not drop.

Probably causes:

- Cavitation in pumps
- Mechanical rubbing
- Gear tooth damage

Yes

Probable causes:

- Incorrect bearing installation
- Insufficient lubrication possibly in combination with minor bearing damage
- Cavitation in pumps
- Mechanical rubbing
- Gear tooth damage

If possible, lubricate the bearing and check the reading at the same time.

When lubricating, check that the lubri-cant penetrates into the bearing.

The reading drops but the dBm increases again within a few hours.

Probable causes: insufficient lubrication which probably has caused minor bearing damage.

The reading drops to normal level and does not increase again. Cause: insufficient lubrication.

The reading does not drop.

Probably causes:

- Incorrect bearing installation
- Cavitation in pumps
- Mechanical rubbing

- Is the instrument and the transducer working ok?
- Is the measuring point correct?
- Is the adapter or the trans-ducer correctly installed?
- Is the machine in operation?

Have normal values been previous ob-served?

NOTE: Be suspicious when sudden drastic changes in readings occur.

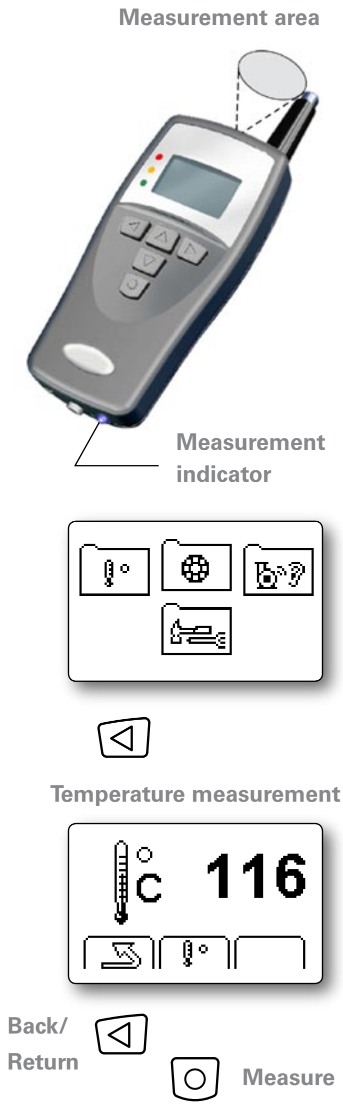
Yes

Probably causes:

- The bearing’s inner ring is slipping on the shaft.
- The bearing’s outer ring is slipping in the housing.
- The reading has been taken just after lubricating a

Temperature Measurement

Temperature measurement is carried out with a contact-free infrared sensor (IR). The sensor is placed on top of the instrument, next to the probe transducer.



The window of the sensor is covered with a filter for infrared radiation. If the window is covered or smudged with some other material, e.g. water, the sensor will not be able to detect the correct amount of radiation and the instrument will therefore give an incorrect reading.

A polished metal surface emits less radiation than a painted surface. If you want to measure on a polished metal surface, you may have to attach a paper label or paint the surface to get a correct reading. Also, bear in mind that a blank surface may reflect heat radiation from surrounding objects.

Emissivity of some common materials:

Brass, polished	0,03
Brass, oxidized	0,61
Copper, roughly polished	0,07
Copper, black, oxidized	0,78
Paint, varnish, black	0,96
Aluminum foil	0,09
Lead, oxidized	0,43
Iron, corroded	0,78
Iron, oxidized	0,84

The viewing angle of the sensor is 60 degrees, giving a measuring area of 36 mm diameter at the distance of the probe tip and 115 mm at a 10 cm distance.

To measure temperature:
From the **Main** display, press the LEFT arrow key to enter **Temperature** mode. Hold the probe tip against the surface you wish to measure and press the measuring key to get a temperature reading. For most accurate results, take two consecutive readings a few seconds apart. Measurement will continue as long as the measurement key, or the probe tip, is being pressed.

To return to the **Main** menu, press the LEFT arrow key.

NOTE
If you are using an optional transducer for shock pulse measurement, measure temperature manually (see instructions in paragraph above).

Machine surface temperature is also measured automatically when an shock pulse measurement is made:
To see the temperature reading after an shock pulse measurement, use LEFT/RIGHT arrow keys to activate the **Return** icon in the **Bearing** display, then press the UP arrow key to enter the **Main** display. Press the LEFT arrow key to enter **Temperature** mode and see the reading. The value presented is always the latest reading, whether automatically or manually (see above) measured. To return to the **Main** display, press the LEFT arrow key.

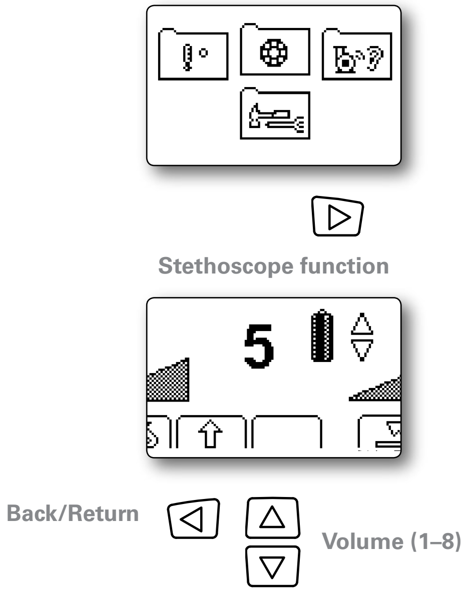
Using the Stethoscope Function

The stethoscope function is useful for detecting machine sound irregularities, such as load shocks and scraping.

Connect your headphones to the output connector (7). From the **Main** display, use the RIGHT arrow button to enter the **Stethoscope** mode. Hold the probe tip against the object. Use UP/DOWN arrow keys to adjust the volume (1-8).

NOTE! Setting the volume to the maximum level may harm your hearing.

To return to the **Main** display, press the LEFT arrow key.



Technical Specifications

Casing/cover:	ABS/PC, IP54
Size:	158 x 62 x 30 mm (6.2 x 2.4 x 1.2 in)
Weight:	185 g (6.5 ounces) including battery
Keypad:	Sealed membrane (silicone rubber)
Display:	Graphic monochrome, 64 x 128 pixels, LED backlight
Bearing condition indication:	Green, yellow and red light LEDs
Measurement indication:	Blue light LED
Power supply:	2 x 1.5 V AA batteries, alkaline or rechargeable
Battery life:	> 20 hrs of normal use
Operating temperature:	0 to +50°C (32 to 122°F)
Input connector:	Lemo coaxial, for external shock pulse transducers (probe or quick connector)
Output connector:	3,5 mm stereo mini plug for headphones
General functions:	Battery status display, transducer line test, metric or Imperial units of measurement, language independent menus with symbols, storage of up to 10 measurement values

Shock pulse measurement

Measurement technique:	dBm/dBc, measuring range -9 to 90 dB_{SV}, $\pm$3 dBsv
Transducer type:	Built-in probe transducer

Temperature measurement

Temperature range:	–10 to +185°C (14 to 365°F)
Resolution:	1°C (1°F)
Transducer type:	Thermopile Sensor TPS 334/3161, built-in contact free IR-sensor

Stethoscope

Headphone mode:	8 level amplification

Article no.

BT2100	Bearing tester

Accessories

TRA73T	External transducer with probe
TRA74T	Transducer with quick connector for adapters
15286T	Belt holder for external probe transducer
15287T	Belt case for accessories
15288T	Protective cover with wrist strap
EAR12	Headphones with ear defenders

Maintenance and calibration

An instrument calibration, e.g. for the purpose of compliance with ISO quality standard requirements, is recommended once a year. Please contact your Timken representative for service, upgrading the software or calibration.

EU Directive on waste electrical and electronic equipment

WEEE is EU Directive 2002/96/EC of the European Parliament and of the Council on waste electrical and electronic equipment.

The purpose of this directive is, as a first priority, the prevention of waste electrical and electronic equipment (WEEE), and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste.

This product must be disposed of as electronic waste and is marked with a crossed-out wheeled bin symbol in order to prevent it being discarded with household waste.

TIMKEN

Bearing Tester

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